

The common polypody abounds on the larger rocks, especially on their shaded sides, and a few clumps of the marginal shield fern grow at the bases of these rocks. *Solidago Curtisii* and two species of blue gentian were fairly common, and a number of other herbaceous plants might be selected in the spring or early summer, when they are in flower.

## SNOW INJURY TO TREES

BY GEORGE B. RIGG

During the winter and spring of 1915-16 the writer has been interested in observing the effects of the unusual climatic conditions on the native trees of the Puget Sound region occurring at or near sea-level, particularly the relative amount of mechanical injury by snow to needle-leaf evergreens and broad-leaf evergreens.

Although the minimum temperatures of this winter were low and the cold spells were prolonged,\* there was not a great deal of serious injury to evergreens from this source. A good many individuals of Douglas fir (*Pseudotsuga taxifolia*), Madrona (*Arbutus Menziesii*) and sticky Laurel (*Ceanothus velutinus*) show more than the usual number of dead leaves, but this does not seem to have interfered seriously with their growth although a few dead Madronas have been reported. The following facts indicate that the winter was a time of relatively severe cold. The minimum temperature was +14° F. on January 11 and the same on January 29. A cold spell began on December 29 and lasted with two slight breaks until February 5. The minimum temperature was below 32° F. many of the days, and from 3 A.M. January 10 to 1 P.M. January 15 the temperature never rose to 32° F. The minimum temperatures of other severe winters were as follows: +3° F. on January 31, 1893; +12° F. on February 3, 1899; +13° F. on January 25, 1902; +11° on January 15, 1907; and +12° on January 13, 1909.

The snow fall in the lowlands of the Puget Sound region is usually very slight. During many of the winters there is not

\* Weather data furnished by G. N. Salisbury, director of Washington Section, U. S. Weather Bureau.

enough snow to cover the ground at any time. The total snow fall for the winter of 1915-16, however, was 60.9 inches at Seattle. It was equally heavy at many other places near sea-level throughout the region. The snow fall of this winter was the heaviest of any winter since the establishment of the local office of the U. S. Weather Bureau in Seattle (1890). Between 9 A.M. January 31 and 2 A.M. February 3, there fell a total of 33.4 inches of snow. There was some settling of this snow due to melting, so that measurements of the total depth on the level at the close of the snow varied from 26 to 29 inches.

The nearest approach to the snow of 1915-16 in amount was in 1892-3 when a total of 58 inches fell. Thirty inches fell in February, but there is no record of the total depth on the ground at any one time. The only other winters during which the records show a total of more than 16 inches are as follows: 1896-7, 31.2 inches; 1898-9, 37 inches.

The snow of January and February, 1916, was very wet and there was but little wind during its fall, so that it accumulated to a considerable depth on all exposed objects offering any considerable surface for its lodgement.

In general there was much greater mechanical injury to needle-leaf evergreens than there was to broad-leaf evergreens. Snow accumulated in large quantities in the tops of young conifers and in many cases this resulted in either uprooting them or in breaking their trunks a few feet from the ground. In the larger individuals among the conifers the greatest injury was by the breaking of branches. The snow did not accumulate in such large masses on the broad leaf trees. The branches bent down with the weight of the snow, and the snow soon slid off from them, the drooping leaves offering practically no resistance to its sliding. The numerous small leaves of the conifers, on the other hand, seemed to offer a firm lodgement for the snow and to offer considerable resistance to its sliding.

Among the conifers, the Douglas fir was a conspicuous sufferer. The injury to this species was the more conspicuous because it is the commonest conifer in the lowlands of the Puget Sound region. Other conifers that suffered severe injury were western hemlock

(*Tsuga heterophylla*), giant red cedar (*Thuja plicata*) and white fir (*Abies grandis*). The injury to the Douglas fir was most striking in logged-off or burned-over areas where there was an almost pure stand of young trees from 10 to 25 years old. The height of young trees of this species is on the average a little over one foot for each year of their age. Many of these young trees had never before borne any weight of snow at all approximating the weight that rested upon them during this winter. Where they grew in a dense stand the accumulated masses of snow frequently uprooted or broke down a number of trees together. Some of these clusters of trees fell at once to the ground while others remained supported for a time by other vegetation which in many cases they finally broke. The writer has not seen any case of injury to conifers occurring singly in the open. The writer has not found any injury of consequence to younger conifers less than 6 feet high, even where they occurred in dense stands in the open. The species examined under these conditions are Douglas fir, lodge pole pine (*Pinus contorta*) and western white pine (*Pinus monticola*).

The region observed by the writer includes the campus of the University of Washington, other places in Seattle and the immediate vicinity, the Cedar River valley east of Seattle, and various points in Kitsap county, Washington in the vicinity of Silverdale, Seabeck, Crosby and Chico.

Several of the trails on the uncleared portion of the campus of the university were rendered impassable by the fall of young conifers during this snow. The same was true of trails and even of roads in Kitsap county.

Considering the large number of species of broad-leaf evergreens in the regions and the great abundance of individuals of some of these species in certain places it was a matter of surprise to find practically no mechanical injury to them from the snow. The Madrona is the largest of these and is also the most abundant in the regions observed by the writer. The others observed, such as sticky balm and manzanita (*Arctostaphylos tomentosa*) are more in the nature of shrubs.

The most striking fact observed about snow injury to trees

was the large amount of injury to needle-leaf evergreens and the small amount of injury to broad-leaf trees and shrubs.

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## THE GENUS *EUGENIA* IN THE HAWAIIAN ISLANDS

BY VAUGHAN MACCAUGHEY

One of the large and representative myrtaceous genera that is represented in the Hawaiian flora by both indigenous and exotic species is the interesting genus *Eugenia*. Several arborescent species are abundant in the rain forests and upper valley floors of all the islands; a number of horticulturally important forms are common in Hawaii's many tropical gardens and estates. Inasmuch as there is nowhere in the literature a comprehensive statement of the Hawaiian *Eugenias*, it is the purpose of this paper to bring together the salient data concerning this group of valuable plants.

The genus *Eugenia* was named by Linnaeus in honor of Prince Eugene of Savoy. It comprises some 760 species, and is the largest genus of the family Myrtaceae. Like several other large genera of this family, it has two main centers of evolution, namely tropical Asia and tropical South America. There are a few species in Africa, and also in Australia; the latter region is also an evolution-center for important myrtaceous genera. Most of the *Eugenias* are trees or shrubs, and many are valued for their fruit, wood, or ornamental foliage.

The leaves are opposite, usually entire, and finely penninerved. They are often glandular-punctate and fragrant. The flowers are in trichotomous terminal and lateral or axillary cymes or corymbs; in some instances they are single or few (on short spurs or buds), in the axils of the leaves. The flowers are white or creamy; the conspicuous part of the flower, however, is the long, numerous stamens, which are white or scarlet. The arrangement is tetramerous; calyx-tube globose to elongate, 4- or rarely 5-lobed, or produced above the ovary with 4 (rarely 5),